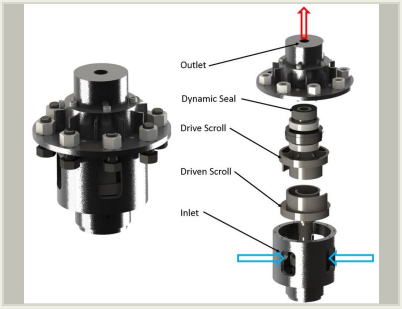
Spinning-Scroll Pump for Cryogenic Feed System, Phase I

Completed Technology Project (2017 - 2017)

Project Introduction

The innovation is an efficient, compact, lightweight, reliable, electric-driven, cryogenic spinning scroll pump (CSSP) capable of pumping liquid methane or oxygen at flows of 8-10 lbm/s. The pump will satisfy propulsion feed system needs stated in SBIR Research Topic Z10.02: Methane In-Space Propulsion. The primary goal is to develop a versatile CSSP, capable of pumping liquid or two-phase methane or oxygen at a wide range of speeds (i.e. 1,000-8,000 RPM) and a wide range of differential pressures while maintaining high reliability and a compact size. For Cryogenic pumping, state of the art (SOA), consists of two vastly different technology options. Centrifugal turbopumps and positive displacement pumps. Turbopumps utilize an impeller-inducer combination that relies on high impeller speeds to create a differential pressure. While the high-speed operation makes turbopumps more compact, it also limits bearing life, differential pressure, and they can't handle two-phase flow. Positive displacement pumps can handle larger pressure differentials and don't have issues with two-phase flow. However, they can't achieve speeds over 3,000 RPM without bulky and high-load bearings. This typically makes positive displacement pumps larger, and consequently, less desirable for aerospace applications. The CSSP offers the best of both options. As a positive displacement pump, it can achieve high-pressure with minimal reduction in flow and pump saturated liquids at low net-positive suction heads. Due to the spinning motion of the pump various centrifugal loads are eliminated, with reduced loading, speeds over 8,000 RPM are possible, making the design compact and lightweight. Additionally, the spinning motion of the scrolls eliminates the need for a counterbalance common in orbiting scroll designs. This further reduces weight by eliminating counterweights and eases bearing loads. Air Squared believes the proposed CSSP is a perfect fit in support of Methane In-space Propulsion.



Spinning-Scroll Pump for Cryogenic Feed System, Phase I Briefing Chart Image

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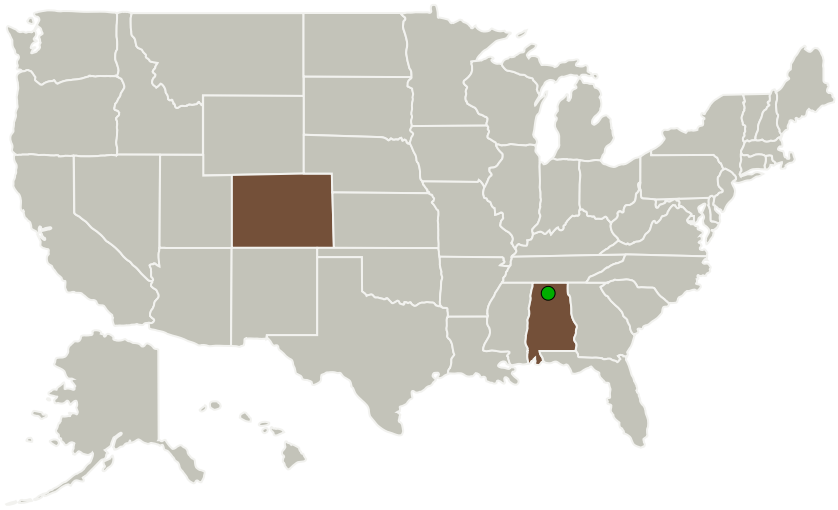
Completed Technology Project (2017 - 2017)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Air Squared Inc.	Lead Organization	Industry	Broomfield, Colorado
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Colorado

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Air Squared Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

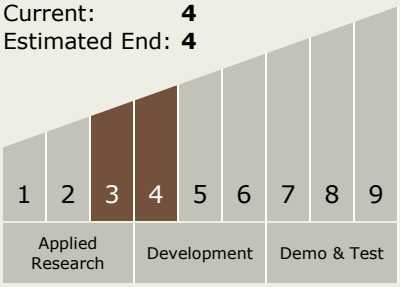
Carlos Torrez

Principal Investigator:

Bryce Shaffer

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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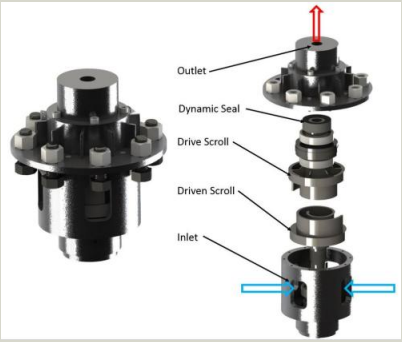
Images



Briefing Chart Image
Spinning-Scroll Pump for Cryogenic Feed System, Phase I Briefing Chart Image
(https://techport.nasa.gov/image/131990)

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.3 Cryogenic